Wind Resource Mapping

by Dennis Elliott and Marc Schwartz 11/99

Background

The National Renewable Energy Laboratory (NREL) is helping to accelerate the deployment of wind energy by producing the most useful and sophisticated wind maps possible. Starting in late 1995, NREL has been developing an automated wind-mapping technique using Geographic Information Systems, or GIS, software, which improves on previous wind-mapping techniques that were limited by laborious and subjective analysis methods.

Determining wind resources in any particular region is often very complex. Previously, resource maps had to be physically drawn for topographic features such as ridge crests, elevated plateaus, and coastal areas. This process was time-consuming, subjective, and often produced inconsistent analyses. NREL's computer mapping technique substantially reduces subjective analysis and greatly improves the accuracy of the maps. The technique enables the analysis of the resource distribution to be treated consistently throughout the region of interest. By using advanced computers, the NREL mapping technique produces a much higher resolution (1 km) and more accurate maps of the wind resource than were previously possible.

Approach

A key component of NREL's wind-mapping effort is the development of updated, comprehensive global databases that supply input for the computerized technique. NREL uses a variety of meteorological and geographical data sets in support of wind-mapping projects. The principal meteorological data used in NREL's resource assessment projects are surface meteorological data, upper-air (weather balloon) data, climatic data sets, and marine wind data from ships and satellites. In some regions, the data are supplemented by surface data from new surface measurement programs. The major type of geographical data used is digital elevation data, which are
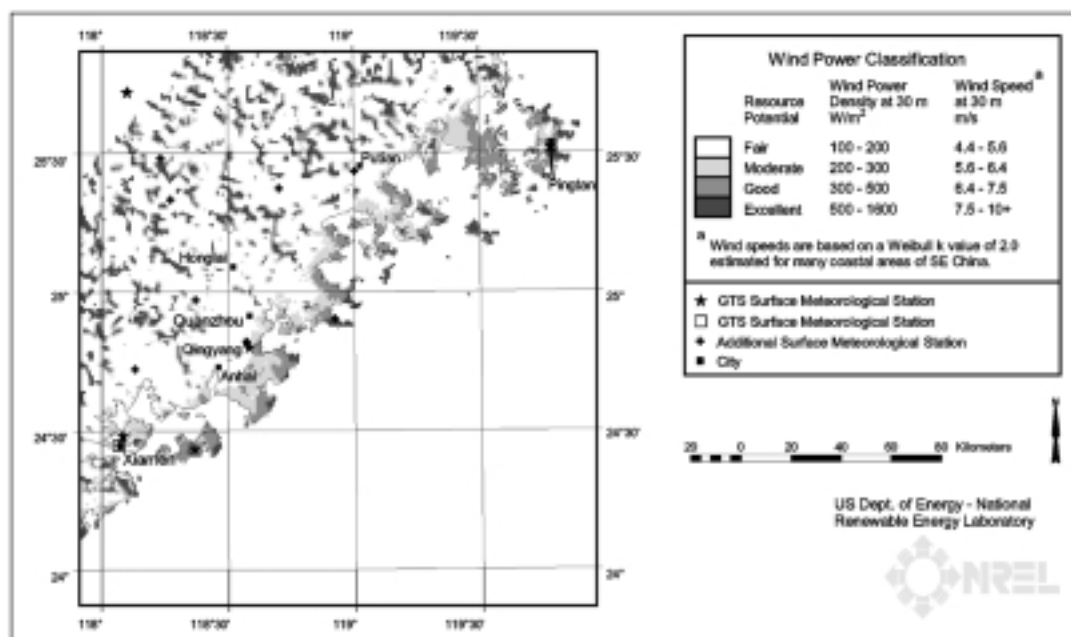

Figure 1. Fujian Province of China.

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used to produce shaded relief maps and also to serve as the basis for the high-resolution wind mapping.

NREL's computer mapping system uses an analytical approach and is designed to portray the distribution of the wind resource over a large area. These maps can be used to identify and target areas for possible project sites and further wind measurement programs.

Results

The wind map for the central coast of the Fujian Province of China (see Figure 1) shows a large region of southeast China with varied terrain. The surface meteorological stations in this region are of limited or no use in assessing the regional wind resource because of anemometer exposure issues. Nevertheless, using advanced analysis techniques of the regional meteorological data (primarily upper-air and satellite data) and available topographic data, a wind map was generated that delineates the most favorable wind resource areas in this region. Wind measurement activities that will be useful in validating and refining the region's wind resource are underway. Wind resource maps generated with the NREL computerized technique have been produced for the whole of the Philippines and the Dominican Republic and for specific areas of Chile, Mexico, China, Indonesia, and the United States.

Planned Activities

Additional wind-mapping activities for the whole of Mongolia, parts of Russia, and additional areas of the United States are underway. These regions present complex wind flow regimes and topography. Additional modules that take extremely complex terrain and topography into account will be developed and added to the computer mapping system.

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